Geological mapping of carbonatites and related ores from the Oulad Dlim massif (Dakhla Province, Morocco) using remote sensing, portable X-ray fluorescence, and mineralogical data

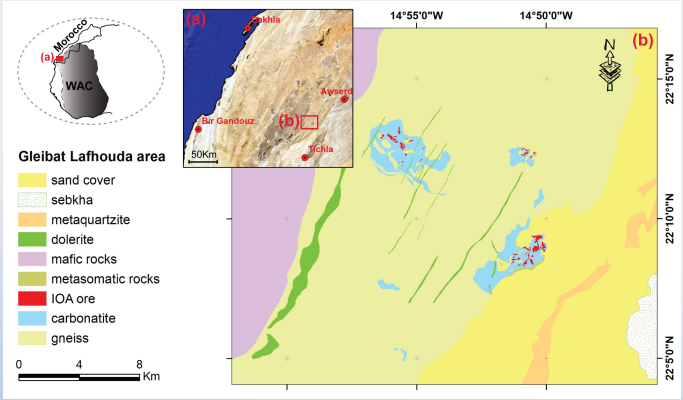
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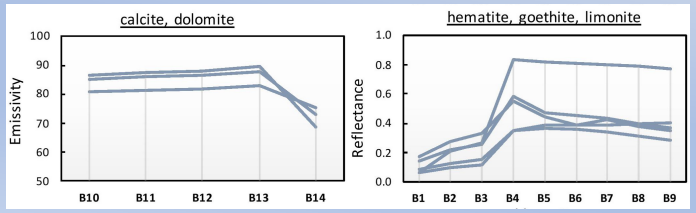
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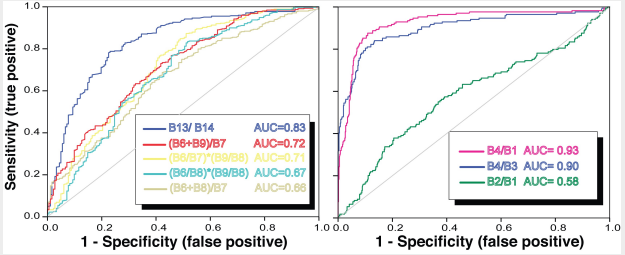
1. Context & study area



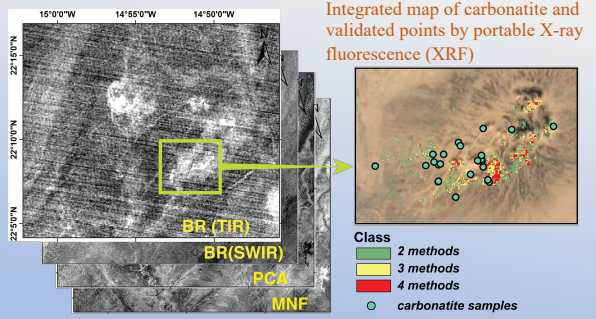
2. Spectral characteristics of carbonatite- and iron oxides-forming minerals



3. Selecting the optimum index using receiver operator characteristic (ROC) curve

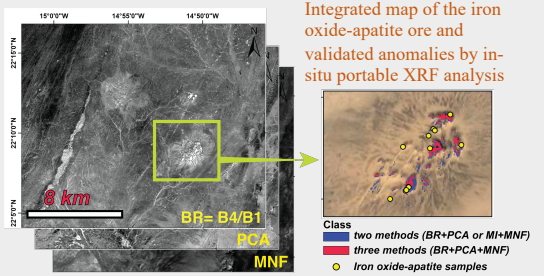


4. Methods integration & field validation

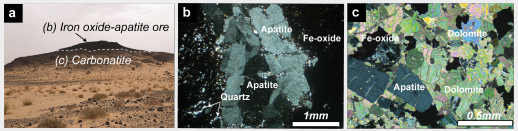


Integrated map of carbonatite and validated points by portable X-ray fluorescence (XRF)

BR: band ratio; TIR: thermal infrared; SWIR: short-wave infrared; PCA: principal component analysis; MNF: minimum noise fraction

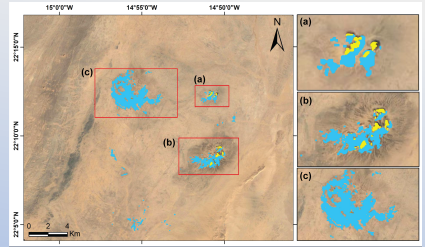


Integrated map of the iron oxide-apatite ore and validated anomalies by in-situ portable XRF analysis



➔ Field photograph (a) and petrographic observations (b, c)

5. ML-based lithological classification



➔ Red classes of the integrated maps were used as training classes in the ML (maximum likelihood) algorithm



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